(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 071 363
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 82303682.7

(51) Int. Cl.³: B 22 D 41/00

(22) Date of filing: 13.07.82

(30) Priority: 24.07.81 GB 8122883

(43) Date of publication of application:
09.02.83 Bulletin 83/6

(84) Designated Contracting States:
DE FR GB IT

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(54) Teapot ladles and refractory tubes for use therein.

(57) A teapot ladle having an interior lining of low thermal capacity, low thermal conductivity refractory material has a pouring spout in the form of a refractory tube (11) fixed to the interior lining below the ladle lip (2), and having a inlet (13) in its sidewall at or near its lower end and open towards the centre of the ladle and an outlet (14) in its sidewall at or near its upper end and open to the lip.

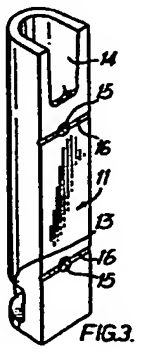

FIG.3.

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TEAPOT LADLES AND REFRACTORY TUBES FOR USE THEREIN

This invention relates to teapot ladles for molten metal and to refractory tubes for use therein.

Teapot ladles are usually fairly small in size, made of steel, are circular in cross-section and slightly tapered outwardly from the bottom to the top. Part of the upper rim of the ladle usually bulges outwardly to form a lip. The ladle is lined with refractory material and the lining has a vertical passageway or spout extending from the cavity of the ladle at the base of the lining to the lip. A pair of trunnions is usually provided on the outside wall of the ladle so that the ladle can be gripped and tilted. When the ladle is tilted molten metal passes through the vertical passageway and is poured out over the lip.

Teapot ladles of this type suffer from a number of disadvantages. To avoid molten metal poured into the ladle cooling excessively, or even freezing, the interior of the ladle must be preheated, and even though teapot ladles are generally of small capacity preheating can take

an hour or more and the process is not only time-consuming but also uses appreciable energy.

After the ladle has been used to hold and pour molten metal the lining must be removed and replaced or at least repaired. In either case the work can be time-consuming, and time is also wasted because of the long period taken for the ladle to cool sufficiently for the relining or repair to be done.

European patent application publication No. 0043670 describes improved ladles, including teapot ladles, which do not suffer from the above disadvantages by having an interior lining formed of one or more floorboards and one or more side boards, the boards being formed of a composition which is refractory, has relatively high heat insulation and a relatively low thermal conductivity.

In such ladles the spout of a teapot ladle for transporting molten metal from the bottom of the ladle to the lip may be provided by inserting a barrier of refractory material extending across the lip portion of the ladle and downwardly towards the floor of the ladle so as to produce a gap between the bottom of the barrier and the floor. In some instances a spout produced in

this way has an excessively large cross-sectional area and it is difficult to hold back slag on the surface of the molten metal and prevent the slag from being poured from the ladle with the molten metal.

Alternatively, when such ladles have an intermediate lining between the ladle casing and the interior lining the spout may be formed by incorporating a preformed refractory tube within the intermediate lining. However, forming the spout in this way increases ladle preparation time and it is not possible to replace the tube without replacing at least part of the intermediate lining.

It has now been found that further improvements in teapot ladles can be obtained by forming the spout from a refractory tube which is fixed to the inner surface of the interior lining.

According to the invention there is provided a teapot ladle comprising an outer metal shell having a lip over which molten metal is poured when the ladle is tilted, a spout extending from near the base of the ladle to the lip, and an interior lining formed of low thermal capacity, low thermal conductivity refractory material which when in contact with molten metal poured

into the ladle forms an erosion resistant surface, in which the spout is formed by a refractory tube fixed to the lining below the lip, the tube having an inlet at or near its lower end and open towards the centre of the ladle and an outlet at or near its upper end and open to the lip.

According to a further feature of the invention there is provided for use in a teapot ladle a tube of refractory material having an inlet in its sidewall at or near one end and an outlet in the sidewall at or near the other end and on the side of the tube opposite to the inlet.

The refractory tube may be made from any suitable refractory material which will withstand the temperature and the erosive action of the molten metal passing through the tube. Examples of suitable materials are castable, vibratable or extrudable refractory compositions based on particulate materials, such as alumina, silica, magnesite or aluminosilicates, and a binder. The preferred materials of this type are compositions containing at least 55% by weight alumina and bonded with calcium aluminate or aluminium phosphate. Compositions which may be vacuum or injection formed to shape and which contain inorganic fibres such as alumina fibres or aluminosilicate

fibres, particulate materials such as those listed above, a binder which may be inorganic or organic and optionally an organic fibre such as paper may also be used. Inorganic binders are preferred because organic binders tend to decompose and evolve hydrogen into the molten metal contained in the ladle. Vacuum or injection formed fibre-containing materials have excellent heat-insulation properties and tubes made from them require little or no preheating before ladles are filled with molten metal.

The tube may be of any cross-sectional shape which is convenient for manufacture and for fitting and fixing against the interior lining of the ladle. Preferably the tube is of essentially semi-circular or essentially elliptical cross-section so that the side of the tube which is in contact with the lining is flat in order to ensure a large area of contact between the two and a better fit. The ends of the tube may be open or closed.

The tube may be fixed to the lining using a material such as a refractory cement or the tube and/or the lining may be provided with means for mechanically locating and fixing the tube in the desired position.

For example when a tube having a flat outlet side is used the interior lining below the lip may have a channel into which the tube may be fitted.

In another embodiment the tube has one or more small cavities in the outer sidewall adjacent to the lining from each of which extends at least one groove to the edge of that sidewall. A similar number of small cavities are provided at corresponding locations in the lining. When molten metal fills the ladle, a small amount penetrates behind the tube into the grooves and into the cavities in the tube and the lining. This metal then solidifies forming solid metal pins which lock the tube in engagement with the lining.

In another embodiment instead of having cavities and grooves in the wall adjacent to the lining the tube may have one or more apertures which align with corresponding small cavities in the lining. When molten metal fills the ladle and passes upwards through the tube a small amount passes through the apertures in the tube into the cavities in the lining, and on solidification forms solid metal pins which hold the tube in position.

Since the sidewall of the ladle tapers slightly outwardly from bottom to top it is preferred that the

inlet end of the tube slopes slightly upwardly from the edge on the inlet side of the tube to the edge on the outlet side so that the side of the tube which is to be in contact with the lining will do so along the whole length of the tube.

In order to hold the refractory tube in position it may also be desirable to engage the lower end of the tube with a floorboard, and this is preferably done by providing a recess in the floorboard and inserting the lower end of the tube in the recess. Alternatively when the bottom end of the tube is open the floorboard may have an upstanding boss and the end of the tube may be fitted over the boss.

It may also be desirable to provide additional support for the upper end of the tube and this may be done by means of a refractory board, for example a silicate-bonded sand board, shaped to fit around the tube and on the top of the lining in the lip portion of the ladle.

The lining material and the construction of the lining system may be as described in European patent application publication No. 0043670.

The interior lining may be formed for example

as one piece or the sidewalls of the ladle, apart from the lip portion, may be lined with a board which is made up of interconnected segmental portions and which can be wrapped around to fit the contour of the ladle. A wedge shaped board is then pushed between the ends of the segmented board to line the lip portion, and hold the whole lining in place.

The invention is illustrated with reference to the accompanying drawings in which:

Figure 1 is a plan view of a teapot ladle according to the invention,

Figure 2 is a vertical sectional view of part of the ladle of Figure 1 and

Figure 3 is an isometric view showing the tube in isolation.

Referring to the drawings a teapot ladle consists of a metal shell 1 of essentially circular cross-section tapering slightly outwardly from bottom to top and having a lip 2 for pouring molten metal. The floor 3 (figure 2) and the wall 4 of the ladle are lined with an

intermediate lining 5 of cast, rammed or vibrated refractory material. A floorboard 6 of low thermal capacity, low thermal conductivity refractory material and having a recess 7 is placed on the intermediate lining 5 on the floor 3 of the ladle so that the recess 7 is in the region of the floor 3 below the lip 2. A wall board 8 made up of interconnected segmental portions and of similar material to that of floorboard 6 is wrapped within the intermediate lining 5. A wedge-shaped board 9 of similar material to that of board 6 is wedged between the ends of the segmented board 8 until the wedge-shaped board 9 is below the lip 2. As shown in Figure 2 the ends of the board 6 and the sides of the board 9 are inclined in complementary fashion for a wedging fit. The wedge-shaped board 9 has two vertically spaced apart cavities 10, each 1.25 cm in diameter and 1.25 cm deep in its major face which is not in contact with the intermediate lining 5. A tube 11 of cast alumina or other suitable refractory material is positioned in the ladle against the wedge-shaped board 9. The tube 11 has a passageway 12 which communicates with an inlet 13 in the sidewall of the tube near the lower end, and with an outlet 14 which in use is open to the lip 2 of the ladle. The sidewall of the tube 11 adjacent to the sidewall of the

interior lining has two 1.25 cm diameter vertically spaced cavities 15, connected by grooves 16, 5 mm wide, to the edge of the wall, and these are aligned with the 1.25 cm diameter cavities 10 in the wedge-shaped board 9. The closed lower end of the tube 11 is inserted in the recess 7 in the board 6 and the upper end may be supported by means of a top board (not shown) which fits over the tube and between the wedge-shaped board 9 and the wall board 6.

The ladle was used to hold and cast molten steel. When the ladle was filled steel entered the passageway 12 of the tube 11 and a small quantity flowed along the grooves 16 into the cavities 10 in the wedge-shaped board 9 and into the cavities 15 in the tube 11 where it solidified thus locking the tube in position and holding it firm while the ladle was emptied.

CLAIMS

1. A teapot ladle comprising an outer metal shell (1) having a lip (2) over which molten metal is poured when the ladle is tilted, a spout extending from near the base of the ladle to the lip, and an interior lining formed of low thermal capacity, low thermal conductivity material which when in contact with molten metal contained in the ladle forms an erosion resistant surface characterised in that the spout is formed by a refractory tube (11) fixed to the lining below the lip, the tube having an inlet (13) in its sidewall at or near its lower end and open towards the centre of the ladle and an outlet (14) in its sidewall at or near its upper end and open to the lip.

2. A teapot ladle according to claim 1 characterised in that the tube (11) is fixed to the lining by means of a refractory cement.

3. A teapot ladle according to claim 1 characterised in that the outlet sidewall of the tube (11) is flat and the tube is fitted into a channel in the lining.

4.. A teapot ladle according to any of claims 1 to 3 characterised in that the lower end of the tube (11) is inserted in a recess (7) in the lining on the floor (3) of the ladle.

5. A teapot ladle according to any of claims 1 to 4 characterised in that the upper end of the tube is supported by a refractory board shaped to fit around the tube and on the top of the lining in the lip portion of the ladle.

6. A refractory tube for use in the teapot ladle of claim 1 characterised in that the tube has an inlet (13) in its sidewall at or near one end and an outlet (14) in its sidewall at or near its other end and on the side of the tube opposite to the inlet.

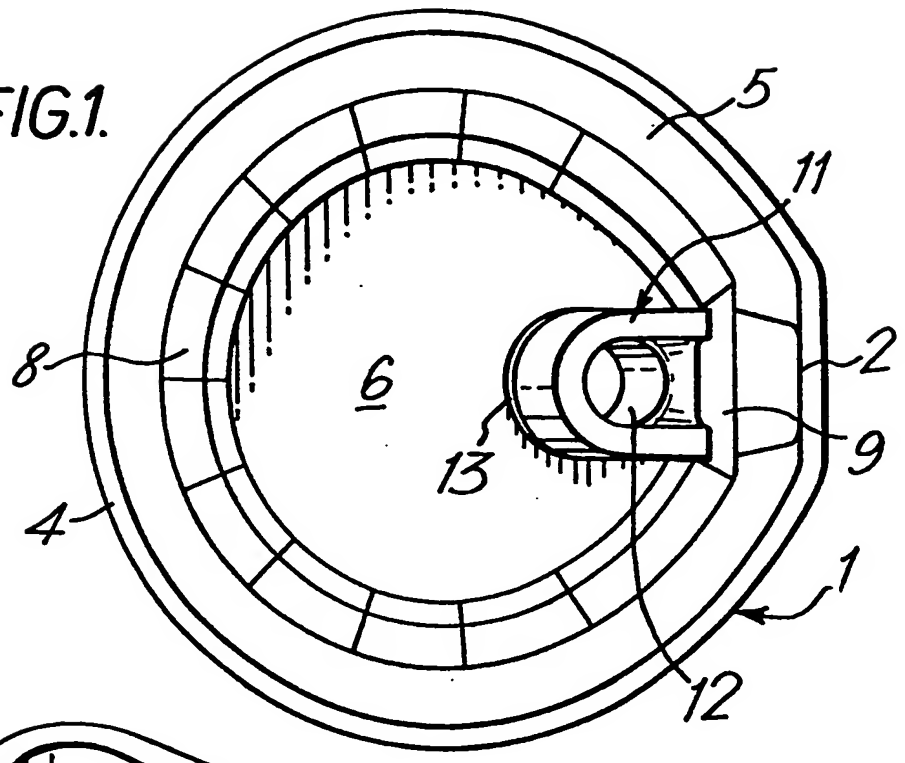
7. A refractory tube according to claim 6 characterised in that the tube is of essentially semi-circular or essentially semi-elliptical cross-section.

8. A refractory tube according to claim 6 or 7 characterised in that the inlet end of the tube slopes slightly upwardly from the edge on the inlet side to the edge on the outlet side.

9. A refractory tube according to claim 7 characterised in that the tube has one or more small cavities (15) in the exterior of the flat sidewall from each of which extends at least one groove (16) to the edge of that sidewall.

10. A refractory tube according to claim 7 characterised in that the tube has one or more small apertures in the flat sidewall.

FIG.1.



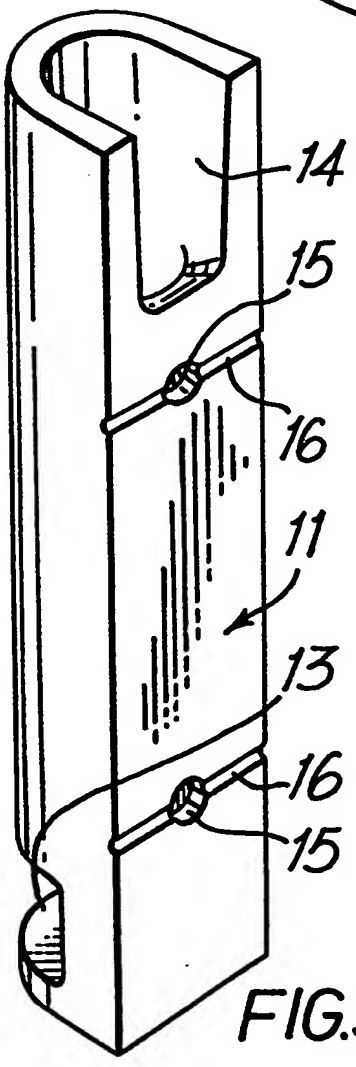
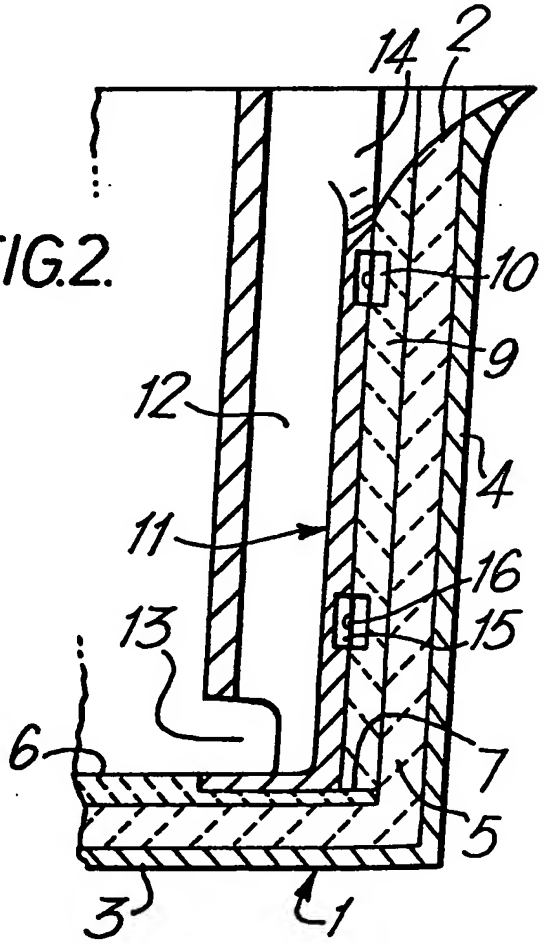


FIG.3.

FIG.2.



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Application number

EP 82 30 3682.7

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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	CH - A - 450 641 (VEB VEREINIGTE BÄCKEREIMASCHINEN WERKE) * fig. *	1	B 22 D 41/00
A	US - A - 2 447 747 (M.W. GOLDBERG) * fig. 1, 2 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

B 22 D 41/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	05-10-1982	GOLDSCHMIDT